

Efforts to Develop National and Regional CFL Market Penetration Tracking to Monitor ENERGY STAR Program Success

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ABSTRACT

Nationwide, investor owned utilities and energy efficiency organizations administer programs to promote energy efficient lighting. Many administrators have adopted the federal ENERGY STAR[®] program framework, thereby creating a network of similar lighting programs across several regions. The market penetration of ENERGY STAR compact fluorescent lamps (CFLs) is one of the most pertinent and reliable indicators of the success of such efforts, including the national ENERGY STAR campaign, itself. Tracking the market penetration of ENERGY STAR CFLs over time can also provide timely feedback on seasonal promotions as well as long-term impacts, as represented by sustained increased shares of energy efficient products.

Growing interest in developing a nationally based clearinghouse of market penetration data that would also support the needs of state and regional program administrators facilitated a feasibility study supported by the U.S. Department of Energy (DOE). This paper discusses the results of the study, including a summary of data needs and requirements, an inventory of current data availability, recommendations for utilizing existing data and collecting sales data from regional and national retailers to develop a market penetration baseline and long term tracking system.

The Importance of Tracking Market Changes

Throughout the U.S., investor-owned utilities (IOUs), regional energy efficiency organizations, and federal, state, and local governments administer programs to promote the production, sales, and installation of energy efficient lighting. With public funds, these entities strive to reduce energy use, criteria pollutant emissions, and greenhouse gas emissions and to encourage efficient use of natural resources. The success of these efforts, in combination with the federal ENERGY STAR program, has increased the types and volume of energy efficient lighting products manufactured, increased the availability of energy efficient lighting products in a variety of retail establishments, and increased the sales of energy efficient lighting products.

Monitoring and documenting the success of the ENERGY STAR program in transforming the market for energy efficient lighting products is important to program administrators, regional energy efficiency organizations, as well as the DOE and U.S. Environmental Protection Agency (EPA). Without *reliable* and *consistent* data however, progress with the spread of ENERGY STAR lighting cannot be properly tracked and measured. Moreover, without state or regional specific data on market penetration, the utility and state

organizations partnering with the DOE and EPA cannot readily assure their regulatory agencies and sponsors that ratepayer or taxpayer funds are allocated effectively. The best way to evaluate the overall market change is with measurement strategies that are applied consistently over time and across regions. This allows for comparisons of trends in areas with and without lighting programs.

Background

Individually, some utilities and organizations administering lighting programs have developed various means to estimate market penetration of some ENERGY STAR-qualified products in their own regions.¹ Additionally, the DOE and EPA are working with lighting manufacturers to collect shipment data on ENERGY STAR qualified products. However, no single comprehensive source of information currently tracks sales of ENERGY STAR qualified lamps compared to other intersubstitutable lamps on a consistent, widespread basis.

Market penetration tracking has been developed for a few states and utilities in recent years. California's Residential Market Share Tracking (RMST) is a comprehensive project that has tracked the sales of residential appliances and HVAC equipment since 1999 and the sales of residential lamps since 2001 (Regional Economic Research 1999, 2000). The RMST data collection method for lamps consists of purchasing and analyzing commercially available point-of-sale (POS) data from established market research firms. The project produces biannual reports presenting quarterly market penetration estimates for the state of California and the service areas for each of California's three major electric IOUs (Regional Economic Research 2001a, 2001b, 2001c, Itron 2002a, 2002b). Similar projects were developed to estimate the market penetration of CFLs for Wisconsin in 2002 and Massachusetts in 2003 (Itron 2004). All three of these projects compare regional and total U.S. market penetration estimates. At the federal level, D&R International has had some success in working with national ENERGY STAR retail partners to collect appliance POS data on a regular basis (D&R International 2004). However, ENERGY STAR partners are not currently required to submit sales data on any product except appliances.

In addition to not having a comprehensive tracking system to judge the success of energy-efficient lamp programs, organizations promoting such products recognize the lack of consistent data and evaluation metrics across programs and regions. A consistent method of tracking sales of energy efficient products would allow for meaningful comparisons between regions and programs, including regions in which no programs exist.

Objective

The objective of this paper is to present key findings of a study funded by the DOE to explore the feasibility of developing a tracking system to document the market penetration of energy efficient lamps purchased for residential use.² This paper discusses 1) an overview of the

¹ It is important to distinguish market penetration tracking from program tracking. Program-tracking data are obtained from program participants and do not include data on sales outside a specific promotion or spilling over from the program.

² The goal of the study is to provide a foundation for additional efforts in obtaining data required for national-level tracking to support DOE and EPA ENERGY STAR program tracking and evaluation needs. The study itself was a cooperative effort, conducted in consultation with regional and state program administrators and evaluators.

market for residential lamps, 2) the data needs and considerations for market penetration estimation and tracking, 3) the availability of data required in a market penetration tracking system, and 4) conclusions and a discussion of next steps.

Overview of the Market for Residential Lamps

To fully appreciate the challenges posed by developing a tracking system for residential lamps, it is helpful to understand the diversity of product (lamp) types and market channels through which lamps are sold.

Lamp Types

Lamps for residential lighting applications include various configurations and types designed for specific lighting functions. Lamps for residential use fall into three major classifications: incandescent, fluorescent, and halogen. Lamps are further classified by configuration - three-way, reflector, medium screw based, linear, circular, etc. The key to tracking the market penetration of CFLs is to identify and track all lamp types that are intersubstitutable with CFLs. This research, therefore, is concerned with all medium screw-based lamps (MSBLs), which includes incandescents (3-way, reflectors, A-line, and globe), halogens (3-way, globe, reflector) and, of course, CFLs.

Lamp Manufacturing, Distribution, and Retail Channels

The manufacturing sector for residential lamps is dispersed and includes hundreds of manufacturers. Lamps reach consumers through a traditional market path – through distributors to retail establishments where lamps are ultimately purchased by consumers. Many large national retailers have their own centralized distribution centers while other regional chains, independently owned, or franchise establishments purchase their inventory through wholesale distributors independent from the retailer and/or product manufacturers.

At the retail level, the market for residential lamps includes six major market channels through which lamps are sold to residential consumers: mass merchandisers, food stores, home centers, independent hardware and home improvement stores, drug stores, and membership warehouses.³ Specialty retailers (such as Lamps Plus), Internet sales, and lamps distributed by utilities fall into a seventh, “Other,” category. Each market channel exhibits a unique retailer mix with respect to sales volume, product mix, ownership characteristics, marketing strategy, corporate structure, and corporate policies. Figure 1 illustrates the relative shares of MSBL sales through five of the seven major market channels in 2002 in the U.S.^{4,5,6} Each market channel is summarized below.

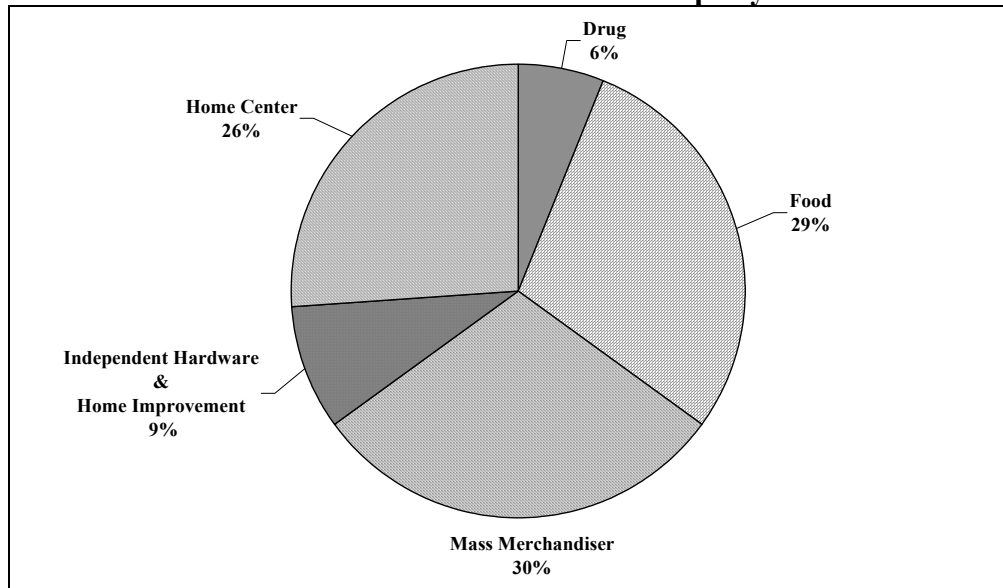
³ Large, nationally based chains typically obtain lighting products directly from the manufacturers while some independent retailers are members of cooperative buying groups that purchase products through centralized distributors.

⁴ Comprehensive data on sales through the club warehouse and “other” market channels are not currently available, however industry professionals speculate that these market channels could account for 20% and 10% of all lamp sales respectively.

⁵ Figure 1 represents sales for residential use; packages of more than twelve fluorescent lamps and more than eight and halogen lamps were omitted from the analysis.

⁶ Data for the grocery, drug, and mass merchandiser market channels represent sales through retailers having at least

Figure 1. Total U.S. Sales of Medium Screw-based Lamps by Market Channel (2002)



Data on sales through membership warehouses and "other" channels are not available.
Source: Itron, Inc.

Mass merchandisers. Mass merchandisers focus on general merchandise retailing. This market channel is dominated a small number of national retail chains with relatively few competing regional chains and local independent storefronts. Of the five market channels shown in Figure 1, mass merchandisers accounted for 30% of MSBL sales nationally in 2002.

Food stores. The food store market channel is dominated by several national and regional food chains that are owned by a small number of national and international corporate parents. At the local and regional level there are a multitude of independently owned and specialty markets. Twenty-nine percent of MSBL sales through the five market channels in Figure 1 were through large food stores nationwide.

Home centers. Home centers are larger retail establishments that serve home improvement needs for both homeowners and contractors. Industry experts estimate that only two national home center retailers account for at least 80% of lamp sales in this market channel. Of the five market channels for which sales data were available in Figure 1, home centers accounted for 26% of residential MSBL sales in 2002.

Independent hardware and home improvement. Independent hardware and home improvement stores offer a less diverse product mix than home centers, focusing more on hardware, tools, and home improvement supplies and less on larger ticket and home design and renovation items. This market channel includes a combination of regional chains and independently owned establishments and franchises. Ace Hardware, True Value, and Do It Best are the most prominent retail franchises in this market channel. Of the five market channels represented in Figure 1, 9% of all MSBLs were purchased through independent hardware stores.

one storefront with total annual revenue over \$2 million.

Drug stores. The drug store market channel includes a mix of national retail chains and independently owned storefronts. Collectively, these retailers represent over 15,400 storefronts throughout the U.S. Drug stores account for only 6% of MSBL sales, the smallest share among the five channels represented in Figure 1.

Membership warehouses. Membership warehouses are establishments that carry merchandise at lower prices than are typically found at traditional retail stores. There are very few national chains that constitute this market channel: To date, data on lamp sales through membership warehouses have not been available. Because consistent data has not been available to date, Figure 1 does not reflect sales through this channel. However, speculation in recent years indicates that CFL sales through membership warehouses could be as high as 20%.

“Other.” The remaining retailers not fitting into the six channels described above include specialty lighting stores (such as Lamps Plus), Internet sales, and distribution of lamps directly from utilities to consumers. Again, consistent data on sales through “other” establishments is not available, and thus this market channel is not represented in Figure 1.

Data Requirements and Considerations

A major component of the feasibility study involved an assessment of data requirements for tracking that would support the market penetration calculation and meet the evaluation and information needs of program administrators and evaluators.

Market Penetration Defined

Developing strategies for data collection and market penetration analysis requires an understanding of the market penetration calculation and the data required for that calculation. In the most general terms, market penetration is defined as *the extent to which a product is purchased by customers in a particular market*. The extent to which a product is purchased is represented empirically by the quantity of units sold. In the specific context of tracking the market penetration of ENERGY STAR qualified CFLs, market penetration is defined as the percent of ENERGY STAR CFLs among all intersubstitutable lamps sold during a specific time period and in a specific region. The market penetration calculation based on ENERGY STAR qualified lamps can be somewhat problematic, however, because 1) the ENERGY STAR specification changes over time, 2) identifying ENERGY STAR qualified lamps in voluminous POS data is extremely time consuming and resource intensive, and 3) doing so increases potential for error and inconsistency if products are not consistently labeled as ENERGY STAR by retailers providing data. An alternative calculation would replace the numerator of the calculation with the quantity of all CFLs sold.

Data Sources

There are several points in the distribution chain at which the quantity of units sold can conceivably be obtained—from product manufacturers, distribution centers, retailers, and consumers themselves. Important considerations include the number of companies/individuals to approach to obtain data, the time lag between when the data are obtained and the final sale to

the consumer, and data reliability, consistency, and accuracy. This study focused on potential data sources that have received the most attention with respect to tracking in recent years: manufacturers' shipment data and retail POS data.⁷

Manufacturer shipment data. The primary advantages of utilizing manufacturer shipment data are 1) it would likely require the cooperation of fewer companies to provide data to cover the same portion of the market and 2) many manufacturers are ENERGY STAR partners and therefore might be likely to participate in such a project. Despite these strengths, shipment data exhibit some characteristics that render them less useful (than retail-level data) for market penetration tracking and program evaluation. Specifically, manufacturer shipment data lack the information on location of where and when the lamps were ultimately sold to consumers. Manufacturer data are useful for tracking lamps to centralized distribution locations only; the areas served by distribution centers can be large, often comprising multiple states. While shipment data can be useful in cross-checking data on the estimates of the total number of lamps in the overall marketplace, the data do not provide enough detail for evaluating specific programs in specific regions.⁸

Retailer point-of-sale data. POS data from retailers exhibits many of the characteristics needed for market penetration tracking. The primary advantage is that retailer data indicate the location and timing of final sale to the consumer – a proxy for location of actual installation (particularly if data are obtained at the store or zip-code level).⁹ Additionally, retail data provide information on the market channel through which lamps are sold – valuable information for program planners in developing program targeting and marketing strategies. The biggest weakness of retailer POS data is the cost to obtain data from a retailer panel for adequate representation in market penetration estimates. As described above, the retailer panel should represent all retailer types - in terms of market channel, sales volume, and mix of products sold - to accurately represent the lighting market overall.

Several specialized market research firms obtain POS data for a wide range of consumer products from retailers throughout the U.S. The data are aggregated and summarized, then become publicly available for purchase. Two firms in particular – ACNielsen and Vista of Activant Solutions – obtain UPC-level data on lamp sales from retailers throughout the U.S. representing the grocery, drug, mass merchandiser, and independent hardware and home

⁷ It is important to note that no primary data source is the best for tracking all products. The most appropriate point in the product distribution network from which to obtain data depends on several factors, such as the product market structure and distribution/retail network, the number of entities involved in the distribution/retail network, and the target market of the program that the market penetration estimates will support. (For example, shipment data would be more appropriate to evaluate an upstream buy-down program, while retail POS data would be more suitable for a downstream rebate program.)

⁸ The National Electrical Manufacturers Association (NEMA) collects CFL manufacturer shipment data from its members. NEMA is already working with CEE on shipment data for premium efficiency motors and currently provides data bi-annually at the national level. Developing a relationship with NEMA in the lighting sector might lead to later agreements with regard to sales data on the market penetration of energy efficient luminaries. However, NEMA does not appear to include all manufacturers of ordinary incandescent A-type lamps. It also does not include most offshore manufacturers. (See http://www.nema.org/index_nema.cfm/534/.)

⁹ While sales data will indicate the timing and location of sale to consumer, displaced watts, and hours of use are separate issues that will determine savings, and are outside the scope of a market penetration analyses and thus the scope this paper.

improvement market channels. These data are available in at least quarterly intervals and have been utilized in the lamp tracking projects for California, Wisconsin, and Massachusetts.

Retail Sales Data Characteristics

In theory, the market penetration calculation is straightforward. In practice, obtaining the required data can be quite complicated. Characteristics of data generated at the point of sale, however, render data from retailers ideal for market penetration tracking. Most retail establishments, particularly large retail chains, employ bar code scanners to read Universal Product Codes (UPCs) to transmit product inventory, pricing, and sales data automatically to a central computer system. UPCs are numeric identification codes with two components: a manufacturer code and a product number. UPC codes are assigned at the manufacturer level to currently available products. When a product is taken off the market, the UPC code for that product is retired, but can be reassigned to a different product in the future. Because UPCs are assigned through manufacturers, products carry the same UPC regardless of their final point of sale to consumers. That is, two identical products sold by different retailers will have identical UPCs. Thus, UPCs are ideal product identifiers when working with POS data from multiple retailers, and should be included in data obtained for market penetration tracking.

The Stock Keeping Unit (SKU) is another unique product identifier often stored in retailers' centralized POS computer systems. SKUs are alphanumeric codes assigned by the retailer that can also be used to identify a product by its unique characteristics. Because SKUs are assigned by retailers, identical products sold by different retailers will most likely have different SKU codes. While SKUs can be useful in analyzing data for a particular retailer, they are not as beneficial as UPCs, which are universal across all retailers.

SKU or UPC level data are ideal for developing market penetration estimates. Data at this level of detail will enable analysts to group products that most appropriately match the terms of the market penetration equation. The alternative of having retailers themselves to group products could introduce considerable error and inconsistency in the data, because there is no way to insure that retailers will group products differently and/or they may not correctly compute the total units sold because they might ignore the number of lamps per package.

Product and Packaging Characteristics

Unique characteristics of lamps pose challenges with respect to data collection and analysis. First, there are technical traits that differentiate lamps within each overall lamp type, such as wattage and whether the lamp is dimmable. These characteristics should be identifiable in data obtained for market penetration tracking and are typically included in the product description fields available in UPC and SKU databases. Second, packaging quantities needs to be taken into account. Data must include not only the number of packages sold, but also the number of lamps in each package. Varying packaging quantities presents another justification for obtaining UPC or SKU level data from retailers. The alternative of allowing retailers to compute the quantity of units sold would generate great uncertainty as to how the total quantity sold is computed (by packages sold or the number of units in each package).

Data Representativeness

Robust estimates of market penetration require sufficient data to represent adequately the relative *mix* of lamp types sold by all retailers and to meet a pre-defined level of precision in the estimate of market penetration. Data must be obtained from different retailers rather than a single retailer to ensure that the sample is representative of establishment types - in terms of mix of products sold and establishments of differing sales volumes, for example. Additionally, estimating the market penetration of lamp types requires a reasonable sample of sales from each of the market channels, more or less proportionate to the total sales through each channel. The absence of a key channel in the market penetration estimate decreases the usefulness of the results for the remaining channels. Omitting any of the market channels must be weighed against the loss in representativeness and the market size of the omitted channel relative to the market as a whole. This also is true for the omission or inclusion of retailers that have significantly different CFL market shares. To the extent that different programs target different channels or retailers, the need for careful delineation of samples within each sample strata is exacerbated.

Regional Segmentation

The overarching goal of this study was to ascertain the feasibility of tracking the market penetration of residential lamps at both the national and regional levels. The geographic region covered by data obtained by retailers will dictate the level at which market penetration information can be reported. For instance, if a national retailer provides data at the national level only, data from that retailer cannot be used to estimate the market penetration of CFLs for smaller areas. Obtaining data for the smallest area possible will allow analysts to define customized regions, such as utility service areas, state boundaries, or multi-state areas. Ideally, POS data should be obtained at the store or zip code level; state-level data would be useful but could prohibit tracking at individual utility areas in those states where programs are offered or evaluated at that level.

Data Interval

To be meaningful in evaluating the success of product marketing, market penetration should be estimated at regular time intervals. The interval at which market penetration estimates can be computed depends on the interval at which data are available from retailers and other sources. The data interval must be frequent enough for project subscribers to discern the effects of market interventions and changes in those interventions. California's RMST has shown that monthly or quarterly intervals can best meet these needs. Semi-annual and annual data might be useful for gauging overall trends, but would lack the level of detail needed for analysis of specific market interventions, changes in technologies, or changes in standards.

Summary of Data Requirements

The previous section summarized key considerations with respect to data collection for market penetration tracking, such as the market penetration calculation, data sources, data characteristics, product and packaging characteristics, geographic region, timing, and data representativeness. A summary of ideal data requirements includes the following:

- Data represent retail sales.
- Data include the quantity of CFLs and all intersubstitutable lamps sold during a specific time period in a specific geographic region.
- Data include the UPC, quantity sold and product description of each unique product sold.
- Data reflect key lamp characteristics, such as lamp type, wattage, and package quantity.
- Data allow for the identification of ENERGY STAR qualified products.
- Data are obtained at the smallest geographic region possible, ideally at the zip code or store level.
- Data are obtained in quarterly intervals to enable program administrators to discern effects of specific market interventions.
- Data are obtained from a representative sample of retailers within each market channel.

While these ideal requirements will provide researchers with the flexibility to estimate market penetration for energy efficient lamps and in specific regions in a way that best meets administrator and evaluator needs, it might not be possible to obtain such data from all retailers and data sources. Minimum requirements for market penetration tracking are 1) data represent retail sales, 2) include the quantity of CFLs and all intersubstitutable lamps sold during a specific period in a specific geographic region, 3) data are obtained in at least quarterly intervals to enable program administrators to discern effects of specific market interventions, and 4) allow for the identification of lamp type.¹⁰

Current Data Availability and Data Collection Recommendations for Market Penetration Tracking

Two key tasks of the feasibility study were to assess the availability of current data that met the minimum requirements and to estimate potential market coverage of any identified sources. Accomplishing these tasks entailed in-depth research into identifying all major national and regional lamp retailers in each market channel, discussions with program administrators and evaluators, and an assessment of data availability through established market research firms.

A summary of data currently available that will meet market penetration tracking requirements is provided in Table 1. While POS data are already available for some market channels from market research firms (primarily grocery and drug channels), primary data collection directly from retailers will be necessary, particularly in the home center, membership warehouse, and mass merchandiser market channels. Fortunately, nearly all of the national chains in these channels are ENERGY STAR retail partners and DOE's existing relationships with these partners could help facilitate data collection. Efforts are currently underway to forge

¹⁰ Note that these minimum requirements will satisfy requirements for computing national market penetration of CFLs. Requirements for regional estimates will depend on the coverage and the mix of retailers providing data.

data-sharing agreements with some of these partners. The combination of the POS data purchased from ACNielsen and Vista with data obtained from the national ENERGY STAR retail partners will result in a representative sample of retailers across all market channels (except the “other” category) to produce a market penetration estimate at the national level.

Table 1. Summary of Data Availability and Recommendations by Market Channel

Market Channel	Coverage by Existing Data Sources	Recommendations for Tracking
Home Center	None identified. D&R is currently negotiating data sharing agreements with national ENERGY STAR retail partners.	Develop data sharing agreements with national ENERGY STAR retail partners. Augment sample with data from regional retailers to support regional analysis.
Independent Hardware	POS data available from Vista. Coverage is adequate at the national level. State-level data are available for select states.	Purchase national level data from Vista and augment sample with data from regional retailers to support regional analysis.
Membership Warehouse	None identified. Efforts underway to contact national ENERGY STAR retail partners.	Develop and maintain data sharing agreements with national ENERGY STAR retail partners.
Drug	POS data available from ACNielsen. Data represent all major drug store chains in most regions.	Purchase national level data from ACNielsen. Purchase state-level data to support regional analysis.
Grocery	ACNielsen data include all major national and most regional chains.	Purchase national level data from ACNielsen. Purchase state-level data to support regional analysis.
Mass Merchandiser	ACNielsen data include two of the three national retail chains, and major regional chains in the western U.S.	Purchase national level data from ACNielsen. Purchase state-level data to support regional analysis. Develop data sharing agreement with ENERGY STAR retail partners.
Others (specialty retailers, internet sales, and utility distribution)	Data on sales through other establishments are not known to be available.	None at this time.

Another recommendation of the feasibility study is to augment the data for a national analysis with retail sales data from prominent regional retailers to support the development of regional market penetration estimates. While national-level market penetration data are valuable in themselves, developing regional estimates will allow for comparisons among regions in addition to providing inputs for the evaluation of specific programs.

Conclusions and Next Steps

As a result of the CFL feasibility study, DOE has strengthened its commitment to developing a CFL market penetration tracking system and has increased its efforts to obtain data from its ENERGY STAR retail partners. Additionally, the project team continues to collaborate with stakeholders throughout the energy efficiency community to coordinate data collection efforts to support the development of regional analyses. Independently, program administrators are increasingly aware of the need for consistent data and are instituting data requirements from key program participants in their respective program areas.

The next steps in developing a market penetration tracking system are to continue to facilitate, support, and coordinate data collection efforts at the national and regional levels. Consistent data obtained through these efforts, in combination with POS data purchased from market research firms, will support the development of a baseline upon which future analyses and market penetration estimates can be developed and compared. The key to success of this effort will be the collection of consistent data across programs and regions, and the support of program administrators and other organizations in developing data collection and sharing protocols.

The feasibility study was the result of a successful collaborative effort of energy efficiency professionals, program administrators, and evaluators throughout the U.S. Contributing differing perspectives, the project team collectively recognized the need for more reliable, comprehensive, and consistent data by which to evaluate and monitor program success. The feasibility study demonstrates a long-term commitment to developing a market penetration system that will benefit national, regional, and state information needs.

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